



# Department of Environmental Protection

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## **DRAFT Fact Sheet** **Guidance on Sampling and Analysis for PFAS at Disposal Sites** **Regulated under the Massachusetts Contingency Plan**

### **INTRODUCTION**

This Fact Sheet, prepared by MassDEP's Bureau of Waste Site Cleanup, provides guidance regarding when it is appropriate to sample and analyze for Per- and Polyfluoroalkyl Substances (together, PFAS) at disposal sites regulated under the Massachusetts Contingency Plan (MCP). It also provides a summary of physical and chemical properties, environmental health impacts, state and federal standards and guidelines, and appropriate analytical methods for PFAS. Two of the most researched and most prevalent PFAS in the environment are perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS).

PFAS may be present at MCP sites as a result of current or past releases associated with the manufacturing, use, or disposal of products containing these chemicals. PFAS are considered hazardous materials under MGL Chapter 21E and potential Contaminants of Concern (COCs).

### **BACKGROUND INFORMATION**

#### What are PFAS?

PFAS are a large group of man-made fluorine-containing chemicals with unique properties to make materials to which they are applied stain and stick-resistant. PFAS are used to repel oil and water from clothing, carpeting, and furniture, in food packaging, and on non-stick surfaces on cookware. PFAS are very resistant to breakdown, migrate easily, and concentrate in the food chain. As a result, they may be found throughout the environment in groundwater, surface water, soil, and air, as well as in food, breast milk, umbilical cord blood, and human blood serum. PFAS have been used for decades in many common products but their presence in the environment is still poorly understood as they have been subject to very limited testing.

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## Human Exposure and Potential Health Effects

Our knowledge of the health risks posed by PFAS is still incomplete. They have been shown to be toxic to laboratory animals, and there is inconclusive evidence that they might cause cancer in animals and humans. Some studies suggest that these chemicals function as endocrine disruptors and mimic fatty acids in the body. The chemicals are not easily excreted and remain in the human body for years (estimated 4 to 8 years). Research has indicated that humans can be exposed to PFAS through inhalation, dermal contact, and ingestion.

The most important route of exposure with respect to environmental exposure is ingestion of contaminated drinking water from contaminated public or private water supplies. These chemicals have been found in a number of drinking water systems due to localized contamination from nearby manufacturing facilities that used PFAS or areas where the chemicals were used in firefighting foams. However, because of their persistence in the environment, PFAS are capable of traveling long distances and may be found far from the locations where they were initially released into the environment.

Other potential exposures to PFAS include ingestion of food that may be contaminated as a result of contaminated soil and water used to grow the food, food packaging, or equipment used to process the food. Exposure to PFAS through inhalation may be a result of PFAS present in commercially-treated products to make them stain- and water-repellent and/or to confer non-stick properties. Exposure through inhalation also may be present at PFAS production facilities or facilities that manufacture goods made with PFAS.

Because these chemicals have been used in an array of consumer products, most people have been exposed to them. Studies have found PFOS and PFOA in blood samples of humans and wildlife nationwide. Scientists detected PFAS in over 98% of the thousands of blood samples collected during the Center for Disease Control and Prevention's (CDC's) 2003-2004 National Health and Nutrition Examination Survey.

## Sources of PFAS at MCP Sites

PFAS have been used in many industries, including aerospace, automotive, construction, manufacturing, electronics, and textiles. PFAS have been used since the 1940s as manufacturer-applied oil and water repellants on products such as clothing, upholstery, paper, and carpets, and were also used in making fluoropolymers for non-stick cookware. PFAS surfactant qualities were also utilized in mist suppressants that can be added to metal plating baths to prevent air releases and to firefighting foams used for fires due to flammable liquids.

Aqueous Film Forming Foams (AFFF) that contain PFOS from seven manufacturers have been used since the 1960s to extinguish highly flammable or combustible liquid Class B fires, such as fires involving gas tankers and oil refineries and at military bases, airports, and firefighting training facilities. Between 2000 and 2002, the 3M Company, the largest

manufacturer of AFFF in the world, voluntarily phased out its production. AFFF has not been manufactured in the United States since 2002 but stockpiles remain at Department of Defense (DoD) bases, airports, and other facilities.

PFOA has been used primarily as an aqueous dispersion agent in the manufacturing of fluoropolymers, which are substances with special properties that have thousands of manufacturing and industrial applications. Well-known fluoropolymers are Teflon™, which is used in non-stick cookware, Gore-Tex® textiles, Stainmaster® carpets, and Scotchgard™.

PFOA and PFOS can also be created by the biotransformation of some fluorinated telomers (i.e., precursor compounds). Fluorinated telomers are used in firefighting foams (as a replacement for PFOS) and as surface protection to provide soil, stain, grease, and water resistance in products such as tile, stone, textiles, and paper packaging.

PFOA and PFOS are no longer manufactured in the United States as a result of voluntary phase-outs and EPA's PFOA Stewardship Program, with a few exceptions for limited industrial uses. As part of the EPA's PFOA Stewardship Program, eight major chemical manufacturers committed to eliminate the use of PFOA and PFOA-related chemicals in their facilities' emissions and product content by 2015. Although PFOA and PFOS are no longer manufactured in the United States they are still produced in other locations around the world and they may continue to be imported into the United States in consumer goods such as carpets, leather, apparel, textiles, paper and packaging, coatings, rubber, and plastics.

Processes and product uses/sources of PFAS include the following:

Processes	Product Uses/Sources
<ul style="list-style-type: none"> <li>• Fluoropolymer coatings</li> <li>• Plastics/polymers</li> <li>• Oil and water repellent (Teflon™, Stainmaster® carpets, Scotchgard™ and Gore-Tex®)</li> <li>• Surfactants used in firefighting foams</li> <li>• Mist suppressants for metal plating operations</li> <li>• Photomicroolithography process to produce semiconductors</li> <li>• Photography and film products</li> </ul>	<ul style="list-style-type: none"> <li>• Some grease-resistant paper</li> <li>• Fast food containers/wrappers</li> <li>• Microwave popcorn bags</li> <li>• Pizza boxes</li> <li>• Candy wrappers</li> <li>• Non-stick cookware such as Teflon™-coated pots/pans</li> <li>• Stain-resistant coatings such as Scotchgard™ used on carpets, upholstery, and other fabrics</li> <li>• Water-resistant clothing such as Gore-Tex®</li> <li>• Adhesives</li> <li>• Aviation hydraulic fluids</li> <li>• Cleaning products</li> <li>• Personal care products such as shampoo, dental floss, and cosmetics (nail polish, eye makeup)</li> <li>• Paints, varnishes and sealants</li> </ul>

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## Standards and Guidelines

On May 19, 2016, EPA released Drinking Water Health Advisories (HAs) of 70 parts per trillion (ppt) applicable to both the individual PFOA and PFOS chemical concentrations and when both PFOA and PFOS are found in drinking water, the 70 ppt HA level is applicable to the combined concentrations of PFOA and PFOS<sup>1</sup>. This HA level offers a margin of protection for all Americans from adverse health effects resulting from a lifetime exposure to PFOA and PFOS in drinking water.

No federal drinking water standards have been established for PFOS and PFOA. The EPA is currently collecting drinking water data to determine if establishing a Maximum Contaminant Level (MCL) is warranted under the Safe Drinking Water Act based on PFOS and PFOA occurrence in drinking water, the number of people potentially being exposed, observed exposure levels, and costs for treatment to reduce levels.

PFAS are considered COCs and subject to be addressed if found at a disposal site regulated under MGL chapter 21E and the MCP. PFAS meet the definition of a hazardous material under Chapter 21E, § 2 and 310 CMR 40.0006(12). Reportable Concentrations and Method 1 Cleanup Standards have not yet been established under the MCP for PFAS. A notifiable condition would exist under the MCP at 310 CMR 40.0311 for PFAS releases that pose an Imminent Hazard pursuant to 310 CMR 40.0311. A Method 2 and/or Method 3 Risk Characterization<sup>2</sup> would apply to the characterization of risk at a disposal site with PFAS as COCs.

## **PFAS SAMPLING AND ANALYSIS CONSIDERATIONS AT MCP SITES**

Under the MCP, the need to sample for specific hazardous materials is determined by the site history, past use of chemicals at the site, and other relevant information that by which the likely presence of oil and hazardous material (OHM) is known, or suspected.

### When to Sample for PFAS

Sampling for PFAS should be considered at locations where the following activities may have occurred or where related wastes have come to be located:

- **Facilities** where PFAS have been manufactured (i.e., chemical facilities) or used (e.g., textile/carpet manufacturers) and may have resulted in contamination to soil and groundwater.

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<sup>1</sup> Drinking Water Health Advisories for PFOS and PFOA: <https://www.epa.gov/ground-water-and-drinking-water/drinking-water-health-advisories-pfoa-and-pfos>

<sup>2</sup> The USEPA has established a Reference Dose of 0.00002 mg/kg/day, documented in the Drinking Water Health Advisory, that would serve as the basis of a MCP Risk Characterization

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- **Landfills<sup>3</sup>** where leaching of PFAS from disposal of products that contain it has resulted in contamination to soil and groundwater.
- **Former or Current DoD sites** where the historic use of PFAS in AFFF may have resulted in soil and groundwater contamination.
- **Airport** hangars and other facilities (e.g., petrochemical) storing firefighting foams.
- **Firefighting training areas.**
- **Crash sites**, including aircraft and motor vehicle sites where AFFF may have been used.
- **Metal coating and plating facilities.**
- **Water treatment systems and receiving water bodies.**
- **Large rail yards.**

The need to sample soil, groundwater, surface water, sediment, or drinking water for PFAS will depend on case-specific conditions and the disposal site Conceptual Site Model. The need for drinking water samples (i.e., from a public or private drinking water well or tap) would be indicated where plume delineation shows potential impacts to a drinking water supply well.

#### How to Sample for PFAS

Because of the potential presence of PFAS in common consumer products and in equipment typically used to collect soil, groundwater, surface water, sediment, and drinking water samples as well as the need for very low reporting limits, special handling and care must be taken when collecting samples for PFAS analysis to avoid sample contamination.

Below is a summary of items that are likely to contain PFAS and therefore **should not be** used by the personnel conducting sampling. Where appropriate, acceptable substitutions are provided in italics.

- Sampling equipment:
  - Pumps and Tubing: Teflon™ and other fluoropolymer-containing materials (*instead, use high density polyethylene [HDPE] or silicone tubing materials*)
  - Passive diffusion bags
  - Low density polyethylene (LDPE) Hydrasleeves (*instead use HDPE Hydrasleeves*)
- Decontamination: Decon 90 (*instead use Alconox® or Liquinox®, potable water. followed by deionized PFAS-free water rinse*)

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<sup>3</sup> This guidance is applicable to landfills and other solid waste facilities for which assessments are conducted in whole or in part under the MCP. Facilities regulated under 310 CMR 16.00: Site Assessment for Solid Waste Facilities may also be required to sample for PFAS as a permit requirement.

- Sample storage and preservation: LDPE or glass bottles, Teflon™-lined caps, chemical ice packs (i.e., Blue ice®) (*instead use HDPE or polypropylene containers with HDPE or polypropylene caps, regular ice in Zip-loc bags*)
- Field documentation: waterproof/treated paper or field books, plastic clipboards, Sharpie® markers, Post-its and other adhesive paper products (*instead use loose plain paper, metal clipboard, ballpoint pens*)
- Clothing: clothing or boots with Gore-Tex® or other synthetic water-resistant and/or stain-resistant materials, Tyvek material, fabric softener (*clothing made of cotton preferred*)
- Personal care products on day of sample collection: cosmetics, moisturizers, hand cream, sunscreen, and other related products
- Aluminum foil
- Food and beverage: pre-packaged food, fast food wrappers or containers

Groundwater, surface water, or drinking water samples should not be filtered as the glass fiber on the filter can potentially absorb PFAS.

#### Field/Equipment Blanks

When sampling for PFAS, it is recommended that additional and/or more frequent field/equipment blanks be collected prior to and during sampling to check for residual PFAS on sampling equipment due to the potential for cross-contamination issues and the need for very low reporting limits.

#### Analytical Methods and Reporting Limits

Chemical and physical properties of PFAS prevent the use of conventional analysis (e.g., gas chromatography/mass spectrometry [GC/MS]) to measure them in the environment. EPA's Method 537, Rev. 1.1<sup>4</sup>, published in September 2009, is a liquid chromatography and tandem mass-spectrometry (LC/MS-MS) method that has been proven to be the most reliable approach for analyzing PFAS in environmental and biological samples. This type of analysis has allowed for more sensitive determination of PFAS in different matrices. The method, as written, is intended for analyzing selected perfluorinated alkyl acids in drinking water using solid phase extraction with LC/MS-MS; however, this method has been modified by analytical laboratories to accommodate other matrices. This method has been validated for 14 different perfluorinated alkyl acids and has minimum reporting limits of 2.9 ppt to 14 ppt in drinking water. The EPA method and the September 2016 *Technical Advisory - Laboratory Analysis of Drinking Water Samples for Perfluorooctanoic Acid (PFOA) Using EPA Method 537 Rev. 1.1*<sup>5</sup> provide guidance to ensure that both branched and linear isomers of select PFAS are properly quantified during analysis.

<sup>4</sup> <https://www.epa.gov/water-research/epa-drinking-water-research-methods>

<sup>5</sup> <https://www.epa.gov/sites/production/files/2016-09/documents/pfoa-technical-advisory.pdf>

The 14 analytes specified in EPA Method 537 Rev. 1.1 and listed below should be the focus of BWSC site investigations at this time.

Before September 2009, there were no validated test methods or standardized data quality criteria. As a result, most PFAS data generated and used in earlier publications and assessments were not based on validated methods and therefore cannot be used for comparison with data currently generated.

**Analyte**

N-ethyl perfluorooctanesulfonamidoacetic acid  
N-methyl perfluorooctanesulfonamidoacetic acid  
Perfluorobutanesulfonic acid  
Perfluorodecanoic acid  
Perfluorododecanoic acid  
Perfluoroheptanoic acid  
Perfluorohexanesulfonic acid  
Perfluorohexanoic acid  
Perfluorononanoic acid  
Perfluorooctanesulfonic acid  
Perfluorooctanoic acid  
Perfluorotetradecanoic acid  
Perfluorotridecanoic acid  
Perfluoroundecanoic acid

**Acronym**

NEtFOSAA  
NMeFOSAA  
PFBS  
PFDA  
PFDaA  
PFHpA  
PFHxS  
PFHxA  
PFNA  
PFOS  
PFOA  
PFTA  
PFTTrDA  
PFUnA

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